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AUTHOR Padial, Antonio; And Others
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ABSTRACT

The Science in Action series is designed to teach practical science concepts to special-needs students. It is intended to develop students' problem-solving skills by teaching them to observe, record, analyze, conclude, and predict. This document contains a student workbook which deals with the basic concepts of weather. Six separate units include: (1) hot or cold; (2) how windy is it; (3) heavy air; (4) water in the air; (5) water from the sky; and (6) what will the weather be like. The units consist of basic introductory information and questions, worksheets, a self-checking quiz, and instructions for experiments. A cumulative test is provided at the end of the workbook, along with a glossary. The teachers guide (which is included) explains how to use the workbook, together with teaching suggestions and enrichment activities for each unit. (TW)

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Weather

Earth Science in Action

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Weather

Earth Science in Action

by Antonio Padial and Winifred Ho Roderman

Science consultants:

E. Jan Null
Meteorologist-in-Charge
National Weather Service Center
Fremont, California

Gilbert Yee
California Teacher of the Year
Fremont, California

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Teacher's Manual

Weather

Antonio Padial and Winifred Ho Roderman

A Janus Earth Science in Action Book

Teacher's Manual written by Susan D. Echaore

OVERVIEW

Why are so many special-needs students lost when it comes to science? One reason is that science involves abstract ideas that learning-handicapped students find difficult to understand.

We wrote *Weather* specifically for the older adolescent with reading and learning problems. Basic science concepts are presented in interesting and easy-to-understand ways.

Weather is part of the Janus *Science in Action* series. This workbook gives your special-needs students a practical knowledge of weather that they can apply to their everyday experiences. Students learn what makes weather change; how to look for signs of weather changes; and how to understand and make their own weather reports.

Designed for Special-Needs Adolescents

Your special-needs students will find *Weather* both challenging and fun. Students gradually build up their skills as they progress through this workbook. Lessons are short so students can finish them in a reasonable period of time. Each lesson teaches one major concept, and concepts are broken down into easy-to-handle steps. Students are actively involved with their learning through hands-on activities and experiments.

Weather is part of the Janus *Earth Science in Action* workbook set. (Other sets are *Physical Science in Action* and *Life Science in Action*.) It can serve as a supplement to or as the core of your science program, and it can help your students meet general or laboratory science graduation requirements.

OBJECTIVES OF THIS WORKBOOK

The Janus *Science in Action* series is designed to teach special-needs students basic and practical science concepts that they can apply to daily living. It also helps students develop problem-solving and thinking skills by teaching them to observe, record, analyze, conclude, and predict.

The objectives of *Weather* are:

- The student will learn some basic ways in which weather is described: temperature, wind speed, air pressure, humidity, and precipitation.
- The student will do simple experiments and activities that demonstrate how to observe weather and the ways it changes.
- The student will learn a basic vocabulary of useful science words that describe weather.
- The student will be able to understand and make use of daily weather reports.

READABILITY

Weather averages below a 2.5 reading level, according to the revised Spache Readability Formula. Target words (words important to understanding the science concepts) are set in boldface type when they first appear in the book. They are listed in the book's glossary and also under "Teaching the Units" in this manual.

We suggest that you review the target words before your students begin a unit. Help students pronounce the words. Encourage students to look up definitions in the glossary. You might also reinforce your students' comprehension with vocabulary exercises and word games.

HOW TO USE THIS WORKBOOK

The Workbook Format

All the units in *Weather* are formatted so students can easily recognize what to do on each page.

Each unit opens with a brief introduction that focuses students on the concepts they'll learn. The introductory page includes topic questions that preset learning, and a short vocabulary exercise, "Before You Start," that readies students for the reading that follows.

Units are divided into one- and two-page lessons. Each lesson is followed by an activity or experiment that reinforces the concepts taught. The final lesson in each unit, "Weather Watch," asks students to make a weather report from their own observations, based on what they've learned.

Most units end with "Check Yourself," a comprehension exercise, and "Check These Out," a list of activities that expand the concepts just taught. These activities are multimodal so that each of your students can complete at least one of them successfully.

Introducing the Book

Get students ready for *Weather* by leading them in a class discussion. Ask them: *Has the weather ever ruined something for you—for instance: a party, a vacation, or a sports event?* Encourage students to tell stories of their own experiences.

Then distribute the workbook. Turn to the contents page and read the unit titles out loud. Ask your students to guess what they'll be learning about weather. Then let them leaf through the book. Comment on the attractive illustrations and interesting experiments they will work on.

Finally, read the introduction out loud, and ask your students to describe today's weather.

Introducing the Unit

Before students start a unit, put up posters and pictures that illustrate the topics they'll learn about. You can then refer students to these visual aids when they have difficulty grasping a concept.

Begin each unit by reading the unit introduction out loud. Encourage your students to guess the answers to the topic questions. (When they finish the unit, students might like to answer the topic questions again, so they can see how much they've learned.)

Have your students do "Before You Start." In addition to the words in this exercise, you might have students look up any other target words in the unit.

General Teaching Suggestions

Help Your Students Succeed

We suggest you keep students together as they work through the book. Set a schedule for each unit, allowing enough time for slower students to complete the work. Your more skilled students can be directed to the activities in "Check Yourself" and other enrichment projects that you might develop.

Walk your students through new exercises and activities when they first appear. As students proceed through the book, they should become able to work confidently on similar pages by themselves.

We strongly suggest that you closely supervise students when they work on the experiments. Guide them through each step and lead them to correct conclusions. Encourage discussion at all times and help students relate the concepts in *Weather* to their daily experiences.

Be Prepared!

Before your students start on *Weather*, review for yourself the concepts taught in the book. Be prepared to explain or expand those concepts. (The bibliography at the end of this manual lists some publications that can quickly give you a general knowledge of weather.) Use visual aids as often as possible to reinforce your teaching.

We strongly recommend that you try out the experiments yourself before assigning them to the class. You'll then have an idea of the problems your students might encounter. Gather together all materials for the activities and experiments before students begin. You may need to adjust some of the experiments and activities to fit the skills of your students.

We suggest that you have bonus activities ready for students who finish a lesson early. (You can find suggested activities in "Check These Out" in each unit and throughout "Teaching the Units" in this manual.) Know what resources are available so you can refer students to them.

End-of-the-Book Exercises

"Show What You Learned," a page of two brief comprehensive tests, ends this workbook. "What's the Answer?" tests your students' comprehension of the major concepts they learned about weather. "What's the Word?" tests their knowledge of some target words.

About the Glossary

Words that appear in boldface type in the text are defined in a glossary at the end of the workbook. Words are listed alphabetically and divided into syllables. Keep in mind that the definitions are purposely narrow to aid your special-needs students in understanding the science concepts taught in *Weather*.

TEACHING THE UNITS

Unit 1: Hot or Cold?

Target Words: *degrees, measure, temperature, thermometer*

Heat in the air, or *temperature*, affects weather more than any other meteorological condition. Heat is the sun's energy that Earth and its atmosphere absorb. Students learn that thermometers are used to measure temperature.

The first "Before You Start" exercise appears on page 4. Explain the glossary to students and show them how to use it.

PAGE 5: What's the Temperature?

Students learn that a weather report uses *degrees* to describe temperature. You might use this opportunity to teach students how to read a thermometer.

PAGE 6: Changing Temperatures

Temperatures are continually changing. Weather reports often predict a day's temperature by stating both the expected low and high temperatures. When temperatures drop or rise, weather becomes colder or hotter.

Students are asked to listen to a day's weather report and record the high and low temperatures.

PAGE 7: Weather Watch

This is the first weather report that students are asked to complete. Students record the temperature three times in one day. Help students conclude that when temperature changes, weather changes.

PAGE 8: Check Yourself

Answers to puzzle: *Across* 3. measure

4. degrees 7. thermometer *Down*

1. temperature 2. high 5. change 6. low

Enrichment Activities

- Changes in temperature affect the amount of gas and electricity people use. Discuss the rising cost of gas and electric bills. And, as a class, make a list of ways people can cut down on those costs.
- Post a regional map of your area. Assign each city or town to a different student. Have students begin keeping a weather chart for that place. For their first assignment, have students bring in the temperature of that city or town on a designated day.

Unit 2: How Windy Is It?

Target Words: *anemometer, block, instrument, miles per hour, rotate, tornado, wind*

Wind is air that moves laterally over Earth's surface. It moves the other conditions of weather, such as temperature, from place to place. Students learn what causes wind and how wind changes weather.

PAGE 10: Moving Air

Heated air rises. As it rises, cooler air rushes into the area where the heated air was. The cooler, rushing air is wind.

Students find out that *heat* makes large blocks of air move.

PAGES 10–11: Experiment 1—How does air move when it is heated?

Materials: *foil, a long pencil (with an eraser), a pushpin or thumbtack, a short candle, matches*

Students find out that warm air rises.

Observations: Heated air pushes the foil up.

Conclusions: 1. b. heated air above the candle
2. a. It moves up

PAGES 12–13: Experiment 2—What happens when heated air rises?

Materials: *2 thermometers, a thin strip of paper*

Students find out that when cold air moves to the place where warm air was, the cold air makes a wind.

The results of this experiment depend on which is hotter—inside or outside the room. The strip of paper will move toward the hotter area, because cold air rushes toward heated air.

Observations: 1. Answer depends on which is hotter—inside or outside the room. 2. Answer depends on which is colder—inside or outside the room.

3. Hotter air

Conclusions: 1. a. Colder air b. Toward hotter air
2. Colder air moves toward the heated air.

PAGE 14: Wind Speed

Students learn that the speed of winds is measured in *miles per hour* with a special instrument called an anemometer. Students learn how to make an anemometer, and then how to use it to measure wind speed.

After students make their own anemometer, take a field trip to a slightly windy place where they can set up the anemometer. Then have students complete the record of wind speed on this page.

(NOTE: in a strong wind, it's difficult to count the anemometer's revolutions.)

PAGES 14–15: How to Make Your Own Anemometer

Materials: *square wood board, 2 pieces of flat wood, thick wood stick (with hole drilled in one end), 4 paper cups, 2 long nails, 4 thumbtacks, a washer, a black waterproof marker, glue, hammer, stack of newspapers*

Making the anemometer is a detailed activity. We suggest you have your class make one together as a group project. (If your school has a woodworking shop, find out if your students can work during or with one of the carpentry classes to make their anemometer.)

Some lumberyards will cut and drill the wood for you. The hole in the thick wood stick must be deeper than the length of the nail.

PAGE 16: Winds Change Weather

When heated air cools, it sinks back to Earth; but because Earth rotates, the air falls in different directions. Thus, a north wind is moving air that comes from the north. All winds carry the temperatures of the places they come from—for example, a north wind brings cold temperatures.

Students learn that winds can cause violent storms like tornados. You might have students discuss wind-storms they have been in.

The photographs on this page and others throughout *Weather* were supplied by local weather bureaus affiliated with the National Oceanic and Atmospheric Administration (NOAA).

PAGE 17: Weather Watch

Students measure temperature and wind speed to complete a weather report. They can use either their anemometer or the wind chart on this page to find wind speed. You might have students use both instruments, and then conclude which tool is better for measuring the speed of wind.

PAGE 18: Check Yourself

1. (When heated air rises, cooler air) **a.** moves to where the air was. **2.** (When heated air cools,) **c.** it sinks back to Earth. **3.** (Winds move in different directions) **d.** because Earth rotates. **4.** (Wind is the cooler air that rushes to the) **b.** place where heated air was. **5.** (Weather can change when) **f.** winds meet air that's warmer or colder. **6.** (Wind is measured by) **e.** how many miles per hour it travels.

Enrichment Activities

- Bring a weather vane to class or have students build one. Explain how it tells the wind direction.
- Have students add wind speeds to the weather chart of their assigned city or town.

Unit 3: Heavy Air

Target Words: *air mass, air pressure, barometer*

Air pressure is the force of air pushing down on Earth. Air pressure varies from place to place. Changing temperatures can change the air pressure, which, in turn, changes weather. Air pressure is measured by barometers.

PAGE 20: Heavy and Light

Cold air is heavier than warm air, so cold air pushes harder against Earth. Weather reports describe cold air in an area as *high pressure*. Conversely, warm air pushes against Earth with less force. Weather reports describe warm air as *low pressure*.

Students learn that air pressure changes constantly. Air pressure that becomes higher (and heavier) is *rising*. Air pressure that becomes lower (and lighter) is *falling*.

PAGE 21: High and Low

Air masses are large areas of moving air. Different air masses have different air pressures and temperatures. As air masses move from place to place, they can change weather. For example, an air mass with a low pressure may bring rain.

PAGES 22–23: Experiment 3—Which is heavier: warm air or cold air?

Materials: 2 pint jars with their covers, bowl of ice and water, bowl of warm water, 2 pieces of cotton string

Students find out how the temperature and the weight (pressure) of air are related. We suggest you closely supervise students for this experiment, since it involves matches and lighted string.

Observations: The air that is heated.

Conclusions: 1. Cold air is heavier than warm air.

2. **a.** Hot air has a low pressure. **b.** Cold air has a high pressure.

PAGE 24: Weather Watch

Students add an air pressure observation to this unit exercise. If you don't have a barometer to measure air pressure, students can call up a TV station, watch or read a weather report, or call the local National Weather Service office.

PAGE 25: Check Yourself

1. (Air pressure is) **b.** how hard air presses against Earth. **2.** (When air has a high pressure) **a.** the air is heavy. **3.** (When air pressure rises) **a.** the air is getting heavier. **4.** (A low air pressure means) **a.** rain or snow may fall. **5.** (Cold air is) **a.** heavier than warm air. **6.** (Air pressure is measured by) **a.** a barometer.

Enrichment Activities

- Have students add air pressure to the weather chart of their assigned city or town.
- Start a class discussion on how students feel in different types of weather.

Unit 4: Water in the Air

Target Words: *condense, evaporate, fog, humid, humidity, hygrometer, water vapor*

Heat causes water to evaporate from a liquid into a gas, or *water vapor*. Students learn that the amount of water vapor in the air (humidity) is another variable of weather.

PAGE 27: Water You Can't See

Water is always evaporating from bodies of water, from our own bodies, from wet clothes, and so on. Students learn that water stays in the air as invisible water vapor.

Heat causes liquid water to evaporate.

PAGE 28: How Much Water Vapor?

Weather reports describe a lot of water vapor in the air as *high humidity* and a small amount of water vapor as *low humidity*. On low humidity days, wet things can dry quickly; on high humidity days, wet things take a long time to dry. High humidity days are usually sticky and uncomfortable.

PAGE 29: Back into a Liquid

Evaporated water eventually condenses into liquid water.

When warm air cools and meets a colder surface, water vapor in the air condenses on that surface. Thus, water vapor condenses on the window and on the outside of the glass of ice water.

PAGES 30–31: Experiment 4—Which holds more water vapor: warm air or cold air?

Materials: a small glass jar with lid, bowl of warm water, bowl of ice water

Students find out that warm air can hold more water vapor than cold air.

Observations: 1. b. Liquid water inside the jar evaporates. 2. a. Water condenses inside the jar.

Conclusions: 1. a. The air now holds *more* water vapor. b. The air now holds *less* water vapor. 2. Warm air holds more water vapor than cold air.

PAGE 32: Weather Watch

Students add humidity to their observations of the day's weather. If you don't have a hygrometer, students can use the charts on this page, which list signs of high and low humidity.

PAGE 33: Check Yourself

1. (Heat makes liquid) b. water evaporate. 2. (Water vapor is) c. the gas form of water. 3. (Humidity is the amount) a. of water vapor in the air. 4. (Water vapor condenses) f. into liquid water. 5. (Fog is made of) e. tiny drops of condensed water. 6. (Weather people use hygrometers to) d. measure the humidity of the air.

Enrichment Activities

- Read to your class and discuss some rhymes and superstitions about weather.
- Have students add a humidity report to their city or town weather charts.
- Make a simple hygrometer. Check the science shelf of your library for how-to books.

Unit Five: Water from the Sky

Target Words: clouds, frozen hail, precipitation, rain, sleet, snow

A cloud is made up of millions of tiny water droplets, which are condensed water vapor. Eventually those droplets fall back to Earth as precipitation: rain, snow, sleet, or hail.

PAGE 35: Sticking to Something Solid

Before water vapor can condense in cold air it needs a solid surface to cling to. Air is filled with millions of particles, such as dust. Water vapor condenses on these particles and forms clouds.

PAGES 36–37: Experiment 5—When does water vapor condense and make clouds?

Materials: glass jar, a bowl half-filled with hot water, hot water in a pitcher, ice in a small plastic bag, matches

Students find out that water vapor clings to solid matter (such as the soot in smoke) in cold air and forms a cloud.

Before students drop a lit match into the jar, ask: *Is there water vapor in the jar?* (Yes.) *Where did the water vapor come from?* (Water evaporated from the hot water poured out of the jar.)

Observations: 1. The match makes smoke. 2. A cloud forms inside the jar.

Conclusions: 1. Warm air 2. The warm air is cooled. 3. Water vapor condenses and makes clouds when warm air is cooled.

PAGE 38: Falling Water

Most precipitation falls as rain. When the air is very cold, water vapor condenses into ice crystals, then falls as snow. Sleet and hail begin as rain, but turn into ice as they pass through layers of cold air on their way to Earth.

PAGE 39: Round and Round

Students review a diagram and complete sentences about the water cycle.

1. Liquid water on the ground *evaporates*. The water changes into *water vapor*. 2. Water vapor goes into the air. As the air cools, the water vapor *condenses*. It changes into tiny drops of liquid water. Those tiny drops make *clouds*. 3. Water and frozen water vapor fall from the clouds as *precipitation*. 4. Precipitation falls on the ground. It becomes *liquid water* that's on the ground.

PAGE 40: Looking at the Sky

Meteorologists can predict precipitation or fair weather from observing certain clouds. Students review some photographs of bad and fair weather clouds, and predict the weather for the rest of the day.

Clouds shown are (top to bottom): **Bad Weather**—nimbostratus, stratus, stratocumulus; **Fair Weather**—cirrus, cumulus, altocumulus.

PAGE 41: Weather Watch

A section on precipitation and cloud observation is added to students' weather report.

PAGE 42: Check Yourself

Answers to puzzle: Across 1. snow
2. precipitation 5. cloud Down 1. sleet 3. rain
4. hail

Enrichment Activities

- Invite an airplane pilot to speak about the different weather conditions he has encountered.
- Show a film about the importance of water to life on Earth.

Unit Six: What Will the Weather Be Like?

Target Words: forecasts, meteorologists, predict

Weather reports often contain weather predictions. These reports are made from information gathered by meteorologists, who observe, measure, and record weather patterns 24 hours a day. Much of their information comes from weather satellites that orbit Earth.

PAGE 44: A Weather Forecast

Students review and answer questions about a weather forecast.

PAGE 45: Weather Watch

Students listen to or read a weather forecast for the following day and then answer questions about that forecast. You might expand this activity and have students also record what actually happened to the weather on that day.

Enrichment Activities

- Arrange a field trip to a nearby National Weather Service office.
- Have students research what to do in weather disasters they might encounter.

Show What You Learned

PAGE 46: What's the Answer?

1. Weather changes when **a.** heat in the air changes. **b.** different kinds of air masses meet. **c.** the amount of water in the air changes. 2. Air pressure **a.** is always changing. **c.** rises when air gets heavier. **d.** is high when the weather is fair. 3. Water changes in these ways: **b.** water changes into water vapor when it evaporates. **c.** water vapor condenses and forms clouds. **d.** water changes into ice when it passes through cold air. 4. Some kinds of precipitation are: **a.** snow. **c.** rain. **d.** hail. 5. Weather reports can tell you **a.** how high and low the temperatures are. **b.** how strong the winds will be tomorrow. **d.** if it will rain tomorrow.

PAGE 46: What's the Word?

1. Precipitation 2. Air Mass 3. Air Pressure
4. Water Vapor 5. Humidity 6. Wind

TEACHING AIDS

Resources

The following organizations have printed and visual materials you may find useful:

- **U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service**, Silver Springs, MD 20910
- **Superintendent of Documents, U.S. Government Printing Office**, Washington D.C. 20402 (Ask for the publication list on weather.)
- **National Audiovisual Center, General Service Administration**, Washington D.C. 20409
- Contact the science departments at the nearby colleges and universities, weather departments at local TV and radio stations, and the local National Weather Service office. They often have valuable suggestions and materials that you can use in your class.

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Introduction

Picture this:

It's a warm summer day. You're getting ready to go to a game. You're not sure of what to wear. The sun is shining, but there are some dark clouds in the sky. You decide to wear a T-shirt and jeans.

Halfway through the game, the weather changes. It starts to rain *hard*! You get soaking wet.

How can you know if weather will change? You can use weather reports. And you can look for signs in the weather that show it may change.

This book will help you learn to do those things. You'll learn:

- what makes weather change;
- how to look for signs that weather may change;
- how to guess what the weather will be; and
- how to understand weather reports.

You'll also learn how to make your own weather reports. And you'll do some experiments that show why some kinds of weather happen.

When you finish this book, you'll be ready for any change in weather—rain or shine!

Unit 1

Hot or Cold?

What's the weather like today? *Hot? Cold? Warm? Cool?*

All those words tell how much heat is in the air. If there's a lot of heat in the air, we feel hot. If there's not much heat in the air, we feel cold.

- How much heat is in the air?
- How does the weather change when the heat in the air changes?

You'll learn the answers in this unit.

Before You Start

You'll be using the science words below. Find out what they mean. Look them up in the Glossary that's at the back of this book. On the lines below, write what the words mean.

1. **degrees** _____

2. **measure** _____





What's the Temperature?

Imagine this:

You're listening to a weather report. You hear the reporter say:

"It's 100 degrees right now."

What's the reporter talking about?

Right! The reporter is talking about how hot the day is. He's telling people how much heat is in the air. In other words, he's giving the **temperature** of the air.

Air temperature is measured by special **thermometers**. The picture shows one kind of thermometer. Notice the numbers on the thermometer. They show the degree, or amount, of heat in the air.

We use those numbers when we talk about temperature. If the weather is hot the numbers are high. If the weather is cold, the numbers are low.

For example, the temperature on a hot summer day might be 100 degrees. But the temperature on a cold winter day might be 10 degrees. What do you think the temperature might be on a cool spring day?

Changing Temperatures

Suppose you hear a weather reporter say this:

"Today's high will be in the 80s."

What is the reporter telling you?

The reporter is telling you what the highest temperature will be during the day. It will be somewhere between 80 degrees and 89 degrees. For example, it may be 82 degrees. Or it may be 88 degrees.

Suppose the reporter also says this:

"Today's low will be in the 60s."

What do you think that means?

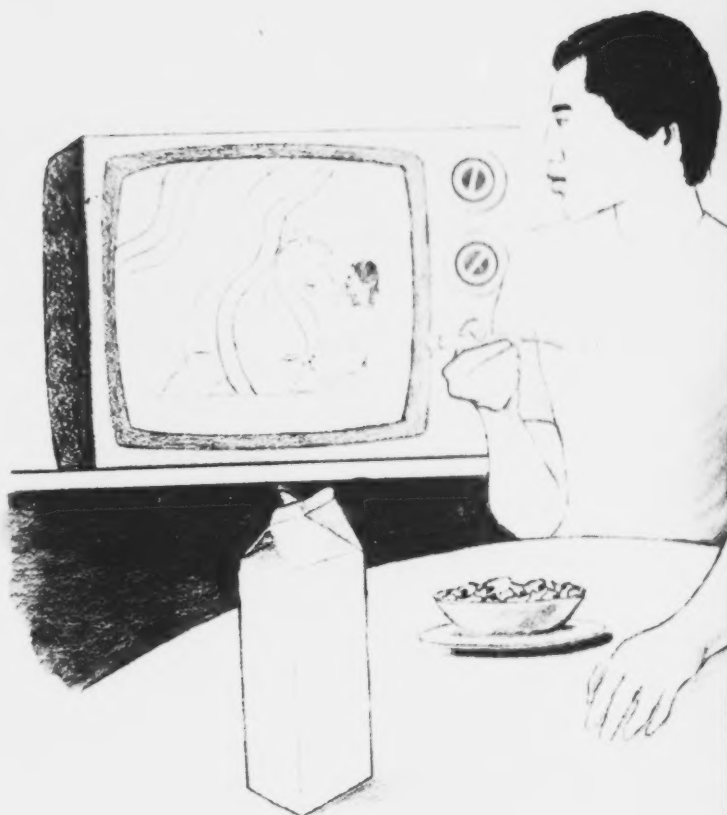
Yes. The lowest temperature during the day will be somewhere between 60 degrees and 69 degrees. It may be 62 degrees, or 66 degrees, and so on.

When the reporter tells you the highs and lows of the day, she's giving you an idea of what kind of weather to expect. She's telling you how the air temperature may change. Often, when the air temperature changes, the weather changes too.

What will be the highest temperature in your area today? What will be the lowest temperature? Find out. Listen to a weather report tonight. Write those temperatures below.

Today's high _____

Today's low _____



Weather Watch

Watch the weather for a day. See how the air temperature changes. See if the weather changes.

Hang an outdoor thermometer outside in a shady place. Put it where the sun can't shine on it.

Look at the thermometer three times a day: once in the early morning; once around noon; once in the late afternoon.

On the weather report below, keep a record of the three temperatures. First, write the day's date. Then, each time you look at the thermometer, write:

- The time (example: 8:30 a.m.)
- The temperature (example: 69 degrees)

Today's Weather Report

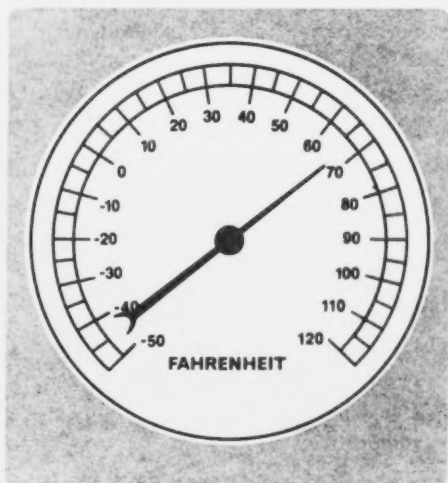
Date _____

Time

Temperature

- | | Time | Temperature |
|----|-------|-------------|
| 1. | _____ | _____ |
| 2. | _____ | _____ |
| 3. | _____ | _____ |

Another kind of air thermometer



What's Happening?

1. Look at the temperatures you wrote. What is the highest temperature?

2. What is the lowest temperature?

3. Did the weather change during the day? If it did, tell what happened.

Check Yourself

Use words from this unit to do the crossword puzzle.
The words you'll need are listed below. The first one is done.

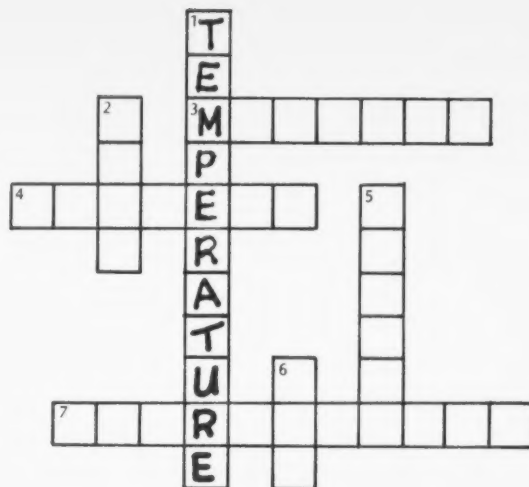
temperature	degrees	thermometer
change	high	low
measure		

Across

3. Find out the amount of something, such as heat
4. Amounts of heat in the air
7. Something that shows how much heat is in the air

Down

1. Heat in the air
2. Highest temperature
5. What weather does
6. Lowest temperature



Check These Out

1. Draw a Fahrenheit thermometer. Write these degrees on it: 110, 90, 70, 50, 30, 10, 0 and 10 below zero. Color the cold temperatures in dark blue and the cool temperatures in light blue. Use pink for the warm temperatures and red for the hot temperatures.
2. Find out what a Celsius thermometer is. How is it different from a Fahrenheit thermometer?

Write some Fahrenheit temperatures on a piece of paper. Find out what those temperatures are on a Celsius thermometer.

3. What's the temperature inside your refrigerator? Inside the freezer? Put a thermometer first in the refrigerator, then in the freezer. Report to the class.
4. Get a newspaper weather report that shows the temperatures around the country. Which city has the hottest temperature?

Which has the coolest temperature? What is the temperature in your area?

5. As you work through this book, you may want to find out more about weather. You can find out more by looking in an encyclopedia or by getting books about weather in the library. You can also talk to an expert, such as a meteorologist or a TV weather person.

Here are some things you may want to find out:

- What is the atmosphere? What is it made of? How does it help make weather?
- How does sunlight help make weather? What kind of light rays reach Earth? What is the greenhouse effect?
- What is climate? How is climate different from weather?



Unit 2

How Windy Is It?

Suppose you heard a weather reporter say:

"It's cool and breezy today."

You know the reporter is describing the amount of heat in the air (*Cool* tells you that.) But the reporter is also describing something else about the weather—**wind**. (*Breezy* means a little windy.)

Winds are part of weather. Just like heat, winds are always changing. And when they change, the weather changes too.

- What is wind?
- What can cause wind?
- How can wind change the weather?

You'll learn the answers in this unit.

Before You Start

You'll be using the science words below. Find out what they mean. Look them up in the Glossary. On the lines below, write what the words mean.

1. **block** _____

2. **instrument** _____

3. **rotate** _____

Moving Air

Hold a sheet of paper in front of your face. Now move that paper quickly back and forth, like a fan. What do you feel on your face?

Did you say, "Air"? But the air was moving. Air that moves is called *wind*. So what you felt was wind, like the wind outdoors.

Air is easy to move. You moved it by fanning the paper. But you moved only a small amount of air. The wind outdoors is a large amount of air—a block. What do you think makes that block of air move?

One answer is heat. When air gets heated, it moves. Then cooler air moves to where that air was. And a wind blows.

When air is heated, it moves a certain way. How does it move? Do the experiment and find out.



Experiment 1

How does air move when it is heated?

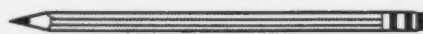
Materials (What you need)



A square piece of foil
(about 5 inches square)



Matches



A long pencil (with an eraser)



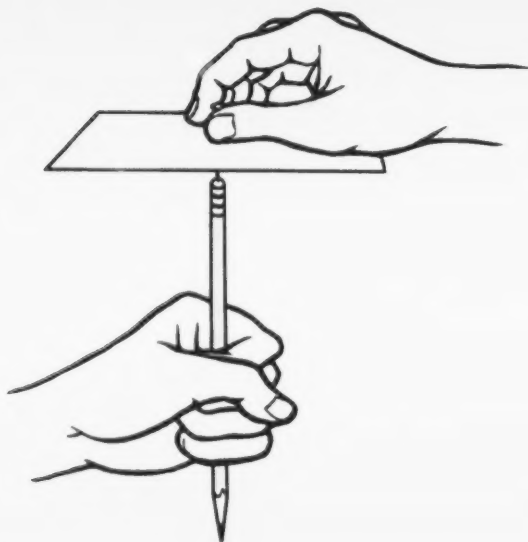
A pin
(such as a pushpin
or thumbtack)



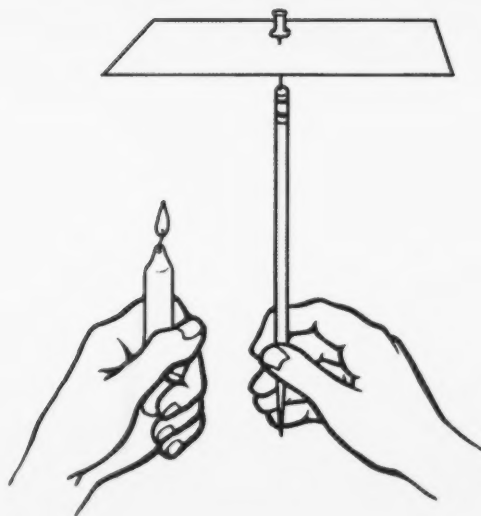
A short candle

Procedure (What you do)

1. Push the pin into the center of the foil. Then push that pin into the eraser of the pencil.



2. Light the candle. It will heat the air above it. Hold the candle below the foil. Wait two minutes. What happens to the foil?



Observations (What you see)

What happens to the foil when you put the candle under it?

Right! The foil moves. The heated air pushes the foil up.

Conclusions (What you learn)

Write **X** in front of the correct answer.

1. What makes the foil move?
☐ a. cold air above the candle
☐ b. heated air above the candle
2. How does heated air move?
☐ a. It moves up
☐ b. It moves down

Experiment 2

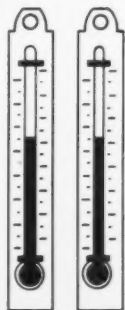
What happens when heated air rises?

When you did Experiment 1, you saw that air rises when it is heated. The air outside also rises when it is heated. The sun heats the things on Earth, such as the ground and the oceans. Those things heat the air above them. And the heated air rises.

When heated air rises, something happens to the colder air around it. What happens? Do the experiment and find out.

You'll need a hot or cold room that has a door or window that can open. You'll also need a place right outside that room, such as the outdoors, a hall, or another room. That place should be colder or hotter than your room.

Materials



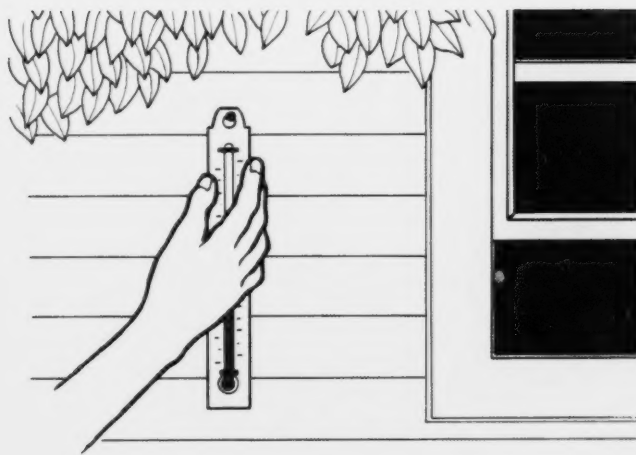
2 thermometers



A thin strip of paper
(about 6 inches long)

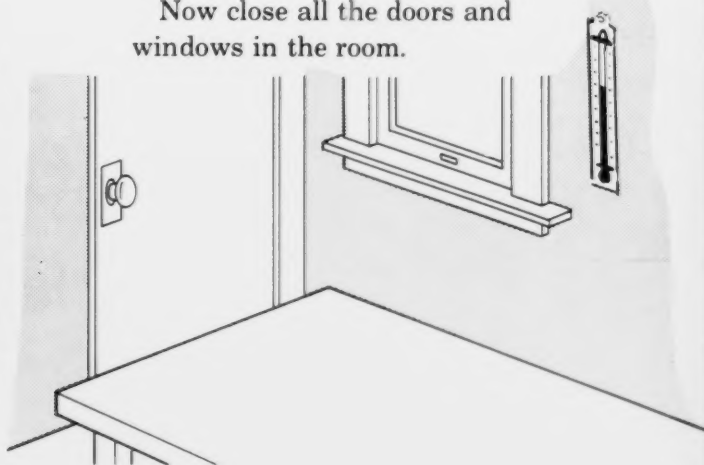
Procedure

1. Hang a thermometer in the place outside your room. Make sure the thermometer is not in the sun.



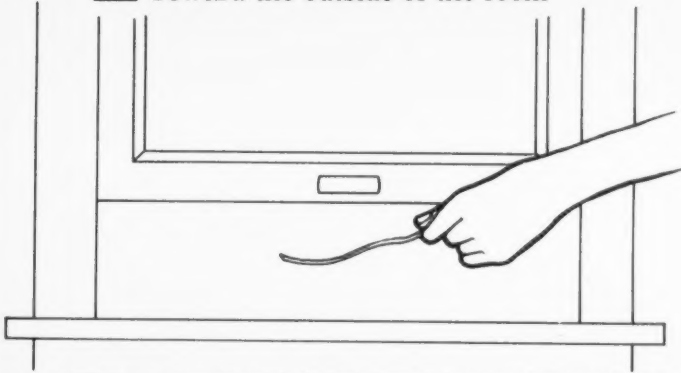
2. Hang the other thermometer inside your room. Make sure the thermometer is not in the sun.

Now close all the doors and windows in the room.



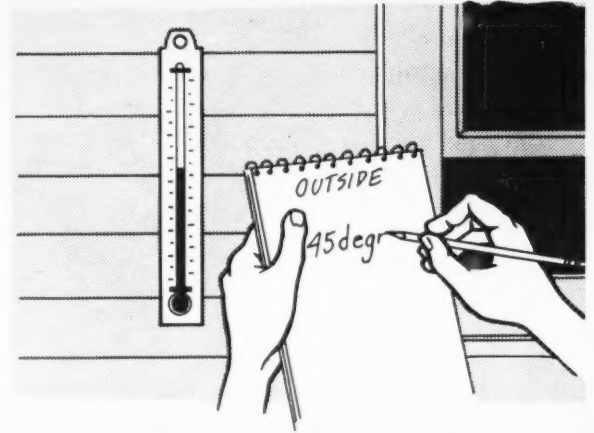
3. Wait ten minutes. Then open the bottom part of a window. (Or open a door.) Hold the strip of paper in front of the open window. (Or hold it above the doorsill.) Look at the strip. How does it move?

- ☐ Toward the inside of the room
☐ Toward the outside of the room



4. Look at the thermometers inside and outside the room. Write the temperatures they show.

_____ Degrees inside the room
_____ Degrees outside the room



Observations

1. Where is the air hotter?

- ☐ Inside the room
☐ Outside the room

2. Where is the air colder?

- ☐ Inside the room
☐ Outside the room

3. What does the strip move toward?

- ☐ Hotter air
☐ Colder air

Conclusions

1. When you open the window (or door), air moves in or out of the room. That moving air moves the strip of paper.

- a. Where does the moving air come from?

- ☐ Hotter air
☐ Colder air

- b. Where does the air move?

- ☐ Toward hotter air
☐ Toward colder air

2. You know that air rises when it is heated. What happens to the colder air around it?

Colder air moves toward the heated air. The colder air rushes to the place where the heated air was. That rushing colder air is wind.

Wind Speed

Winds can be gentle. And they can be very strong. Whether they are gentle or strong depends on how fast they move—their speed.

We measure the speed of a wind by how many miles it travels in one hour. We say that a wind travels so many **miles per hour**. For example, a gentle wind may have a speed of 15 miles per hour. And a wind during a storm may have speeds up to 60 miles per hour.

Weather watchers use a special instrument called an **anemometer**. The anemometer measures the speed of winds. You and your class can make a simple anemometer. Just follow the directions on the next page.

After you've made the anemometer, go outside and measure the wind speed. Write the wind's speed below.

Record of Wind Speed

Date: _____

Time: _____

Wind speed: _____



How to Use Your Anemometer

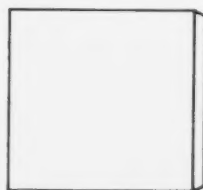
1. Take a watch and your anemometer to a windy place. Set up the anemometer.
2. Count the number of times the black cup spins around in 30 seconds.
3. Divide that number by 5. Your answer will be the speed of the wind. (For example, suppose the black cup spins 45 times in 30 seconds. $45 \text{ divided by } 5 \text{ is } 9$. The wind speed is 9 miles per hour.)

How to Make Your Own Anemometer

What You Need



2 pieces of flat wood
(each about 15 inches long,
1 inch wide, ¼ inch thick)



A square wood board
(about 12 inches square)



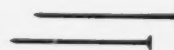
A thick wood stick,
(about 12 inches long,
with a hole drilled in one end)



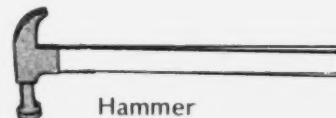
A washer



4 paper cups
(with the top half cut off)



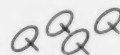
2 long nails



Hammer



Glue



4 thumbtacks



Black waterproof marker

What You Do

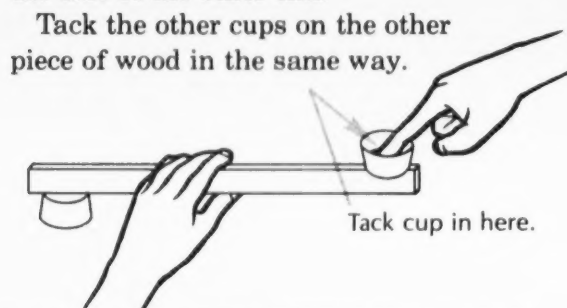
1

Put the board on the stick (on the end that doesn't have a hole). Nail the board to the stick.



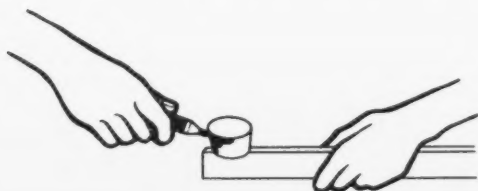
2

Tack one cup into the side of one end of a piece of flat wood. Turn that piece of wood over. Tack another cup to the side of the other end.



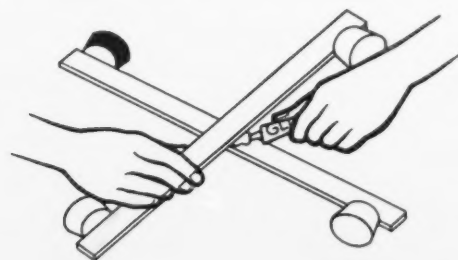
3

Use the black marker and color one of the cups. Color it completely.



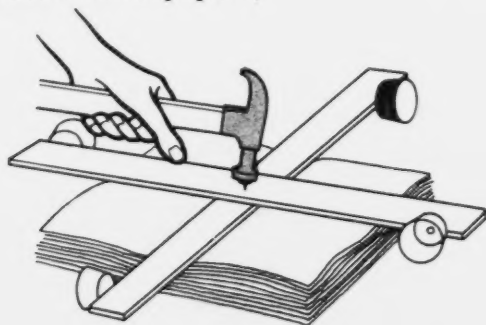
4

Glue the two pieces of wood together in the form of a cross.



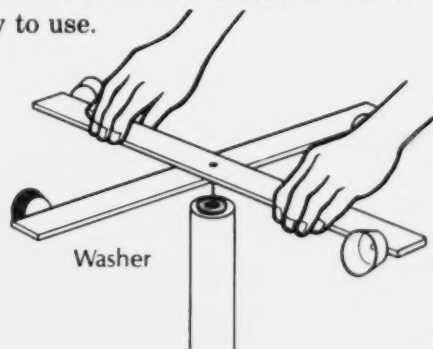
5

Hammer the nail into the center of the cross. (Hammer it on top of a thick stack of newspapers.)

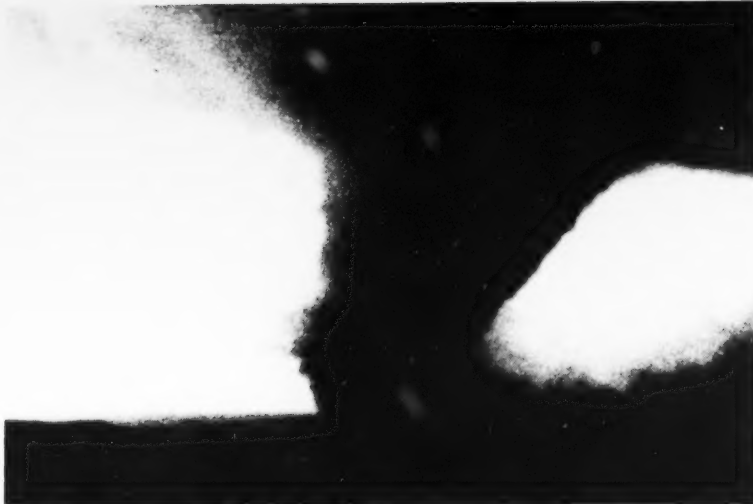


6

Put the washer over the hole in the stick. Fit the nail into the washer and the hole. The anemometer is now ready to use.



NOAA photo



A tornado

Winds Change Weather

When you did the two experiments, you saw how small amounts of air move. Large blocks of air above Earth move in the same way. They become heated and rise. And cooler air—winds—rush in to take their place.

But heat is just one thing that causes wind. The way Earth moves also causes wind. How does Earth move?

Earth spins, or rotates. Its rotation makes air move.

As the air above the land and oceans becomes heated, it rises. Then it cools off and sinks down again. Earth's rotation moves that sinking air into different directions. That moving air becomes wind.

When weather reporters describe winds, they tell what direction the winds come from. For example, a wind from the north is called a *north wind*.

Winds from different directions have different temperatures. And when they meet air that's warmer or colder, they change the weather. They bring snow or rain. Or they stop a storm.

Winds can also cause storms. One example of a windstorm is a **tornado**. In a tornado, winds whirl round and round at terrific speeds and with terrific force. What other kinds of windstorms do you know about?

Weather Watch

You've learned how to measure wind speed with an anemometer. Here's a way to guess wind speed without an anemometer.

You'll need trees and the wind chart on this page. The chart shows what the wind speed might be if different parts of trees move. For example, if small branches move, the wind is about 13 to 18 miles per hour.

Fill in today's weather report. Use a thermometer and an anemometer or the chart.

Wind Chart

How the trees move	Wind speed (miles per hour)
Leaves move just a little	4-7
Leaves and small twigs move	8-12
Small branches move	13-18
Small, leafy trees sway	19-24
Large branches move	25-31
Large trees move	32-38

Today's Weather Report

Date: _____

Time: _____

Temperature: _____

Wind speed: _____

Check Yourself

Show what you learned in this unit. Finish these sentences. Draw a line from the words on the left to the correct words on the right. The first one is done.

- | | |
|--|--|
| 1. When heated air rises, cooler air _____ | a. moves to where that air was. |
| 2. When heated air cools, | b. place where heated air was. |
| 3. Winds move in different directions | c. it sinks back to Earth. |
| 4. Wind is the cooler air that rushes to the | d. because Earth rotates. |
| 5. Weather can change when | e. how many miles per hour it travels. |
| 6. Wind is measured by | f. winds meet air that's warmer or colder. |
-

Check These Out

- | | |
|---|--|
| 1. Find out how a weather vane works.
Draw a picture of one and explain it to the class. Or find out how to make one. Then make it. | 6. Here are more things you may want to find out: <ul style="list-style-type: none">• How does the atmosphere circulate? How would it move if Earth didn't rotate?• What's a cold front? A warm front? What kind of weather does each bring?• What are prevailing winds? Trade winds? Horse latitudes? Doldrums? How did these winds get their names?• What kind of weather does an east wind bring? A west wind? A north wind? A south wind? |
| 2. For one week, keep a daily record of the wind direction. | |
| 3. Suppose you were living on the beach. You would have a sea breeze during the day. And you would have a land breeze during the night. Find out why that is. | |
| 4. There are many kinds of windstorms. Find out about one. Make a drawing or a story about what it might be like if such a windstorm hits your area. | |
| 5. Find out what the words <i>wind chill factor</i> mean. Then explain this sentence to the class: "It's 25 degrees with a wind chill factor of 16 below zero." | |



Unit 3

Heavy Air

You learned that weather reporters describe weather by talking about temperatures and winds. They also describe weather by talking about the weight of air.

Air can be heavy, or air can be light. But its weight is always changing. When the weight of air changes, weather also changes.

- How do weather reporters describe the weight of air?
- How does weather change when the weight of air changes?
- How is the weight of air measured?

You'll learn the answers in this unit.

Before You Start

You'll be using the science words below. Find out what they mean. Look them up in the Glossary. On the lines below, write what those words mean.

1. **air mass** _____

2. **air pressure** _____



KGO-TV, Channel 7, San Francisco

A weather reporter describes air pressure.

Heavy and Light

Imagine this: It's a cold and windy day. You turn on a TV weather report. The reporter says:

"Low pressure air is over us."

What do you think the reporter is talking about?

The reporter is talking about the weight of air pushing on Earth.

When reporters describe the weight of air, they don't tell us how much air weighs. Instead, they tell us how hard the air presses against Earth—its pressure. They tell us if that pressure is *high* or *low*.

Heavy air presses harder than light air. So, heavy air has a high pressure.

Light air doesn't press hard. Light air has a low pressure.

Air pressure is always changing. It becomes higher or lower. When it starts getting higher, weather reporters say the air pressure is *rising*. When it starts getting lower, reporters say the air pressure is *falling*.

Is air getting heavier or lighter when its pressure rises?

Is air getting heavier or lighter when its pressure falls?

Right! Air is getting heavier when its pressure rises (gets high). And air is getting lighter when its pressure falls (gets low).



High and Low

You learned that air moves. Sometimes an area of moving air is hundreds of miles wide. That large area of air is called an air mass.

Air masses move far over our land. Some air masses have high pressures. And some have low pressures.

Different kinds of air masses can change the weather. For example, an air mass with a high pressure may bring fair weather. But an air mass with a low pressure may bring rain or snow.

Look at the weather map on this page. That map is from a newspaper weather report. The map shows the air pressure over three cities. And it shows what the weather will be like in those cities.

What is the air pressure over Denver?

Yes! The air pressure is low.

What will the weather be like in Denver?

Right! It's going to rain in Denver.

What is the air pressure over Atlanta?

What will the weather be like in Atlanta?

What is the air pressure over Chicago?

What will the weather be like in Chicago?

Experiment 3

Which is heavier: warm air or cold air?

Air pressure is always changing. So the air above you is always getting heavier or lighter. What do you think makes air heavier or lighter?

One answer is the temperature of the air—how warm or cold the air is.

Which is heavier: warm air or cold air? Do the experiment and find out.

Materials



2 empty pint jars
and their covers



A bowl of
ice and water



A bowl of
warm water



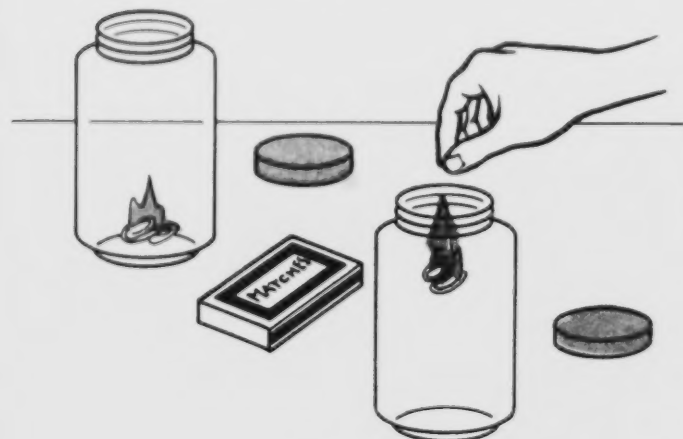
2 pieces of cotton string
(each 1 foot long)



Matches

Procedure

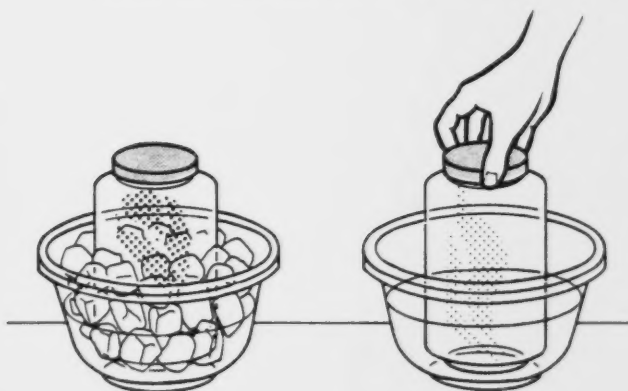
1. Roll or twist each piece of string into a loose ball. Set the strings on fire. Drop them into the jars.



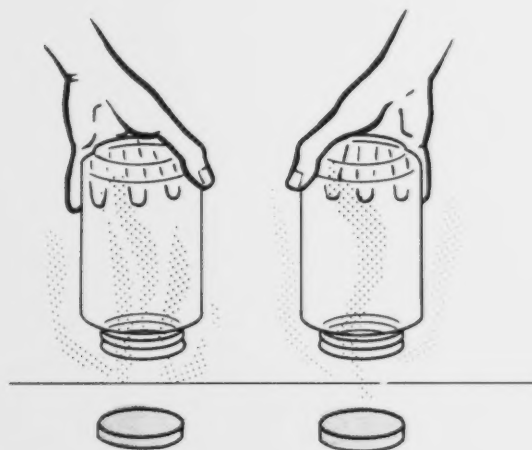
2. Cover both jars tightly.



3. Put one jar into the bowl of warm water. Put the other jar into the ice water. Let the jars fill up with smoke.



4. When the jars are filled with smoke, take them out of the bowls. Open both jars. Quickly turn them upside down.



Observations

When you open the jars, smoke rises out of them. The smoke lets you see what happens to the air in the jars. The smoky air that rises faster is lighter. Which rises faster, the heated air or the cooled air?

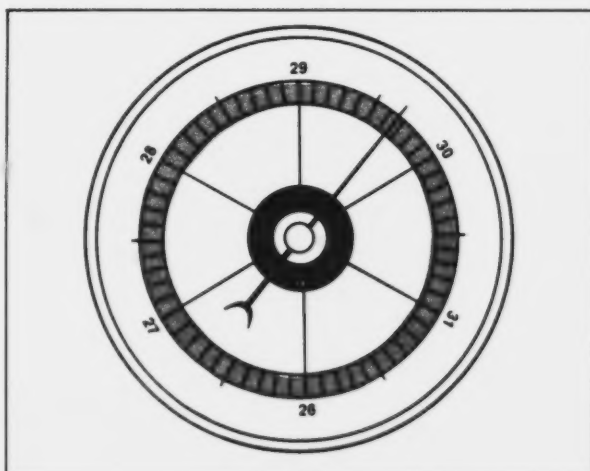
- ☐ The air that is heated
☐ The air that is cooled

Conclusions

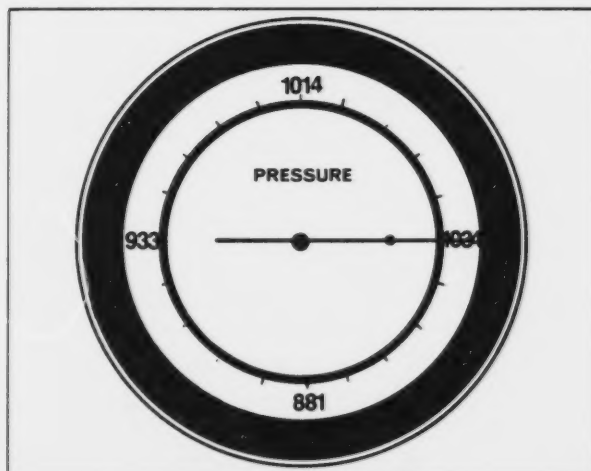
1. Which is heavier: warm air or cold air?

Right! Cold air is heavier.

2. What kind of air has a low pressure? What kind of air has a high pressure? Write *Cold* or *Hot* in the sentence each belongs in.
- a. _____ air has a low pressure.
b. _____ air has a high pressure.



A home barometer



A barometer that's used in weather stations

Weather Watch

A **barometer** is an instrument that measures the pressure of air. The pictures on this page show two kinds of barometers.

Many people keep a barometer in their homes. If you know someone who has a barometer, borrow it and bring it to class. Then fill in the weather report below.

If you don't have a barometer, you can find out the air pressure in one of these ways:

- Telephone a TV station and speak to a weather reporter.
- Watch a TV weather report of your area.
- Get a weather map, like the one on page 21, from a newspaper.
- Telephone a National Weather Service office in your area.

Today's Weather Report

Date: _____

Time: _____

Temperature: _____

Wind speed: _____

Air pressure: _____

Check Yourself

Show what you learned in this unit. Put an **X** in front of the correct words that finish the sentence.

- | | |
|--|--|
| 1. Air pressure is
_____ a. how fast air moves.
_____ b. how hard air presses against Earth. | 4. A low air pressure means
_____ a. rain or snow may fall.
_____ b. fair weather. |
| 2. When air has a high pressure
_____ a. the air is heavy.
_____ b. the air is light. | 5. Cold air is
_____ a. heavier than warm air.
_____ b. lighter than warm air. |
| 3. When air pressure rises
_____ a. the air is getting heavier.
_____ b. the air is getting lighter. | 6. Air pressure is measured by
_____ a. a barometer.
_____ b. an anemometer. |
-

Check These Out

- | | |
|--|--|
| 1. Air pressure is always changing. When air pressure changes, the weather also changes. For three days, keep a record of the air pressure and the weather in your area. Find out what the air pressure is in the morning and in the afternoon. Then write what the weather is like (fair, windy, etc.). | 4. Here are more things you may want to find out: <ul style="list-style-type: none">• What are molecules? What happens to molecules in the air when the pressure changes?• Who was Evangelista Torricelli? What did he discover?• What are cyclones? What are anti-cyclones? How are they different from each other? How do winds circulate in cyclones and anti-cyclones? |
| 2. Find out how a mercury barometer works. What happens to a mercury barometer when air pressure falls? When air pressure rises? | |
| 3. In some towns and cities people can dial a phone number for a weather report. Find out if your town or city has such a number. Look in the phone book under <i>weather</i> . Call that number. | |

Unit 4

Water in the Air

Did you know this? The air around you has water in it. That water helps make weather.

Air can have a lot of water in it. And it can have a little. The amount is always changing. When the amount changes, weather sometimes changes too. So, weather reporters often tell us how much water is in the air.

- How does water get into the air?
- Why does the amount of water in the air change?
- How do weather reporters talk about water in the air?

You'll learn the answers in this unit.

Before You Start

You'll be using the science words below. Find out what they mean. Look them up in the Glossary. On the lines below, write what the words mean.

1. **condense** _____

2. **evaporate** _____

3. **humid** _____





Water You Can't See

Let's say it's raining. The rain makes puddles of water on the sidewalk. Then it stops raining and the sun comes out. What happens to the water in the puddles?

Right! The water dries up. It *evaporates*.
Where do you think the water goes?

Water goes into the air.

Water can be in three forms: It can be a solid, a liquid, or a gas. When water freezes and turns into ice, it is a solid. When solid water (ice) melts, it turns into liquid water. And when liquid water evaporates, it turns into a gas that goes into the air. We call that gas **water vapor**.

Liquid water is evaporating all the time. It evaporates from oceans and lakes, from rivers and pools. It evaporates from trees and other plants. It evaporates from anything that is wet.

As liquid water evaporates, water vapor floats into the air. When the water vapor stays in the air, we say the air "holds water."

What do you think causes liquid water to evaporate?

The answer is heat.

You've seen many times how heat causes water to evaporate. For example, you've seen how wet clothes become dry when they are in the sun.

What's another example of how heat causes water to evaporate? Write it here.

How Much Water Vapor?

It's a hot, uncomfortable day. The air feels heavy and sticky. You listen to a weather report. The reporter says:

"The humidity is high today."

What do you think the reporter is talking about?

The reporter is talking about how much water vapor is in the air—the **humidity**.

Humidity is the amount of water vapor the air in one place holds. A *high humidity* means that the air holds a lot of water. What does a *low humidity* mean?

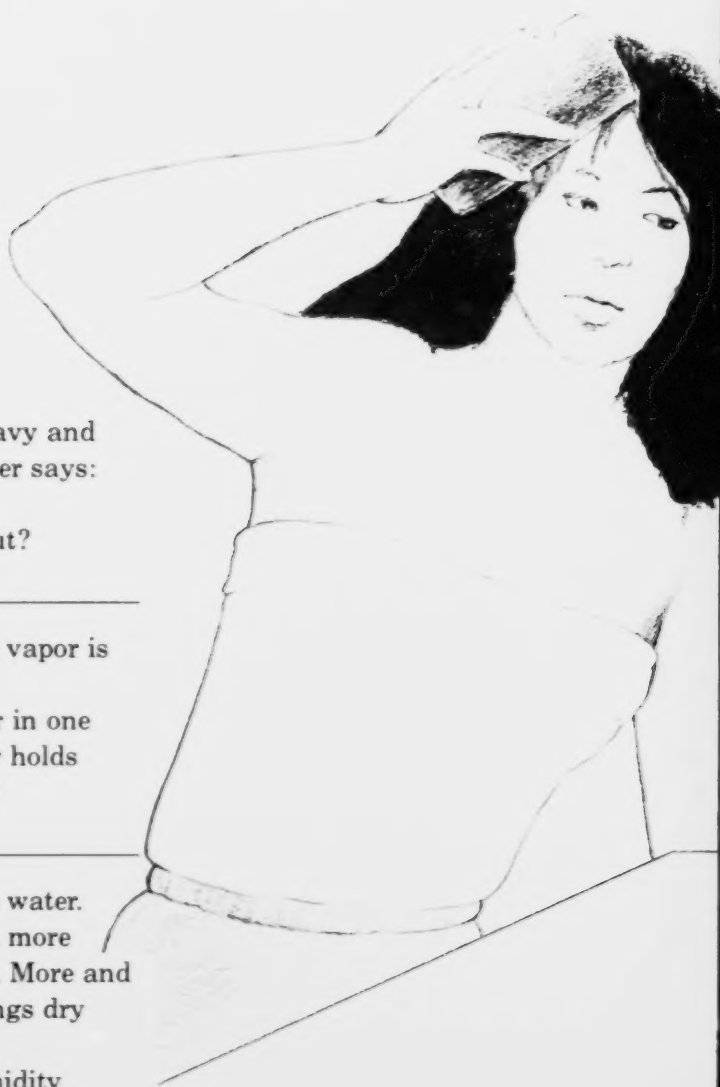
A low humidity means that the air holds little water.

Air that has a low humidity can take in much more water vapor. So, liquid water evaporates quickly. More and more water vapor goes into the air. And wet things dry quickly.

As the air fills with water vapor, the air's humidity rises. Now the air can't take in as much water vapor. So, liquid water evaporates slowly. And less and less water vapor goes into the air. Do wet things dry quickly or slowly when the humidity is high?

When the humidity is high, we say the weather (or the air) is humid. In humid weather, our skin feels wet and sticky. Why do you think this happens?

Our sweat can't evaporate easily in humid weather. So we feel wet and sticky.



Back into a Liquid

Have you ever seen this? Tiny drops of water on grass, leaves, and cars early in the morning.

Suppose that water doesn't come from rain. Where do you think it comes from?



That water comes from the air.

You learned that liquid water evaporates. It changes into water vapor. And the water vapor goes into the air.

But the water vapor in the air can change too. It can change *back* into liquid water. When that happens, we say the water vapor *condenses*.

When large amounts of water vapor condense, the weather changes. For example, water vapor can condense and make **fog**. In a fog, millions of tiny drops of liquid water float in the air close to the ground.

You can easily make water vapor condense. Do this: Breathe hard on a cold glass window. What happens to the place you breathe on?

The place you breathe on is covered with tiny drops of water. Water vapor in your warm breath condenses when it touches cold glass.

Now, do this: Fill a glass with ice and cold water. Put that glass in a warm place. What happens to the outside of the glass? Why does it happen?

Experiment 4

Which holds more water vapor: warm air or cold air?

You learned that air masses are always moving over the land. They carry water vapor with them. And they can change the weather at the places they go to.

One air mass may hold more water vapor than another air mass. How much water vapor a mass holds depends on the temperature of its air.

Does warm air or cold air hold more water vapor? Do this experiment and find out.

Materials



A small glass jar
(with a tight lid)



A bowl of ice water



A bowl of warm water

Procedure

1. Put water vapor in the jar this way:
Breathe hard into the jar. Stop when the inside is covered with condensed water.
2. Quickly put the lid tightly on the jar.



3. Put the jar into the bowl of warm water. Wait one minute. Then take the jar out. What happens to the condensed water inside the jar?



4. Now put the jar into the bowl of ice water. Wait one minute. Take the jar out. What happens to the glass inside the jar?



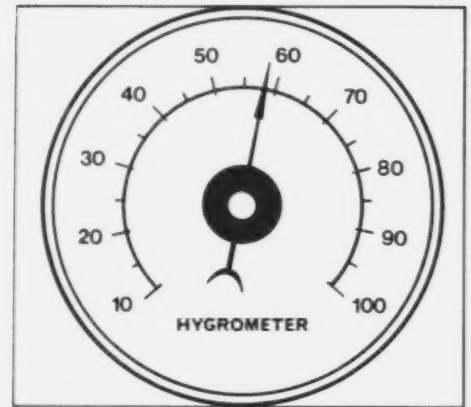
Observations

1. What happens when the jar is put into warm water?
_____ a. More water condenses inside the jar.
_____ b. Liquid water inside the jar evaporates.
2. What happens when the jar is put into ice water?
_____ a. Water condenses inside the jar.
_____ b. Liquid water inside the jar evaporates.

Conclusions

1. Write *less* or *more* in these sentences.
 - a. When the jar is put into warm water, the air in the jar becomes warm. The liquid water evaporates. It changes into water vapor. The air now holds _____ water vapor.
 - b. When the jar is put into ice water, the air in the jar becomes cold. The water vapor in the air condenses. It changes into liquid water. The air now holds _____ water vapor.
2. Which holds more water vapor: warm air or cold air?

Right! Warm air holds more water vapor than cold air.



A hygrometer measures humidity.

Weather Watch

Weather people measure humidity with an instrument called a **hygrometer**. You probably don't have a hygrometer. But you can usually guess if the humidity is high or low. How? By looking for certain signs.

The charts on this page list some signs of high and low humidity. Use them to see if the humidity today is high or low. Then finish the weather report.

Signs of High Humidity	Signs of Low Humidity
• The air feels damp and heavy. • Glasses of cold drinks condense quickly. • Sweat stays on skin, so skin feels sticky. • Wet clothes take a long time to dry. • Clouds build up in the sky.	• The sky is clear and has no clouds. • Clouds are getting smaller. • The skin feels dry. • Often the temperature is very low.

Today's Weather Report

Date: _____

Time: _____

Temperature: _____

Wind speed: _____

Air pressure: _____

Humidity: _____

Check Yourself

Show what you learned in this unit. Finish these sentences. Draw a line from the words on the left to the correct words on the right.

- | | |
|--------------------------------------|-------------------------------------|
| 1. Heat makes liquid | a. of water vapor in the air. |
| 2. Water vapor is | b. water evaporate. |
| 3. Humidity is the amount | c. the gas form of water. |
| 4. Water vapor condenses | d. measure the humidity of the air. |
| 5. Fog is made of | e. tiny drops of condensed water. |
| 6. Weather people use hygrometers to | f. into liquid water. |
-

Check These Out

1. Look for the signs of high and low humidity listed on page 32. Keep a record of what you see and feel for one week. And keep a record of the humidity for each day.
2. On the West Coast, summers are often cold and foggy near the ocean. Find out why.
3. Here are more things you may want to find out:
 - What happens to the molecules in water when water evaporates? What happens when water condenses?
 - Why does heat make water evaporate quickly?
 - What is relative humidity? What is dewpoint? How are humidity, relative humidity, and dewpoint connected to each other?
 - How much water is on Earth? Where is most of that water found—on Earth or in the atmosphere?
 - Which parts of the world always have low humidity? Which parts always have high humidity? Why do those parts of the world always have low humidity or high humidity?

Unit 5

Water from the Sky

Every day, tons of water evaporate. They go into the air as water vapor. Sooner or later, most of that water vapor condenses.

Water vapor condenses on or near the ground. It also condenses in the sky, high above the ground.

Sooner or later, most of the water in the sky falls to the ground. It falls as rain, snow, sleet, and hail. When it falls the weather changes.

- How does water condense in the sky?
- How does water fall from the sky?
- What causes snow, sleet, and hail?

You'll learn the answers in this unit.

Before You Start

You'll be using the science words below. Find out what they mean. Look them up in the Glossary. On the lines below, write what the words mean.

1. frozen _____

2. precipitation _____





Sticking to Something Solid

You learned that water vapor condenses into liquid water. But it won't condense unless it has something to stick to. That thing must be a solid.

Suppose you take a hot shower. The air in the bathroom becomes hot. It holds a lot of water vapor. That water vapor condenses when it touches something solid. What does it condense on?

It condenses on solid things such as walls and mirrors.

We can't always see the things water vapor condenses on. For example, fog is made up of tiny drops of condensed water that float in the air. What do you think water vapor condenses on to make fog?

Air is filled with millions of tiny solids. Some of the solids are dust. Some are tiny bits of ash that come from smoke. Water vapor condenses on those tiny solids. And we see fog.

Water vapor condenses the same way in the sky. It condenses on tiny solids that float high in the air. Sometimes the tiny drops of condensed water gather together. What do you think they form when that happens?

They form clouds.

Experiment 5

When does water vapor condense and make clouds?

Water vapor in warm air condenses on tiny solids. And the condensed water makes clouds. But water vapor condenses only when something happens to the air it's in. When does water vapor condense? Do this experiment and find out.

Materials



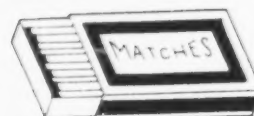
A clear glass jar



Hot water



A bowl half-filled with hot water



Matches



Ice in a small plastic bag

Procedure

1. First, warm the jar. Fill it with hot water. Wait for one minute.
2. Pour the water out of the jar. The air in the jar will become warm. That air will be full of water vapor.



3. Light a match and drop it into the jar. The match will go out right away.



4. Stuff the bag of ice into the top of the jar. Make sure the top is completely covered. Put the jar into the bowl of hot water.



Observations

1. The match makes something inside the jar. What is it?

The match makes smoke. Tiny solids in the smoke go into the air inside the jar.

2. What happens inside the jar when you put ice on it?

Yes! A cloud forms inside the jar. Water vapor condenses on the tiny solids and makes a cloud.

Conclusions

1. What kind of air is in the jar before you put ice on it?
Write *cold air* or *warm air*.

2. What happens to the warm air when you put ice on the jar?

Right! The warm air near the ice is cooled.

3. Now, finish this sentence.
Water vapor condenses and makes clouds when
w _____ air is c _____.



Falling Water

Suppose the tiny drops of water in a cloud grow big and heavy. The cloud can't hold them. What happens to the water?

The water falls to the ground. It falls as rain or sleet or hail.

Water that falls from clouds is called *precipitation*. Rain, sleet, and hail are different kinds of precipitation.

When a lot of precipitation falls, weather reporters say the precipitation is heavy. What do you think they say when a *little* precipitation falls?

Yes! The precipitation is light.

Precipitation usually starts from a cloud as **rain**. But sometimes, the rain passes through very cold air. It freezes and falls to the ground as drops of ice. We call those drops of ice **sleet**.

Sometimes the rain falls through many layers of cold and warm air. Then the rain freezes and turns into balls of ice. We call those balls of ice **hail**.

Another kind of precipitation also falls from clouds. But it is frozen when it leaves the cloud. What is that frozen precipitation?

Yes! That frozen precipitation is **snow**. But snow is different from sleet or hail. Sleet and hail are frozen water. Snow is frozen water vapor.

Round and Round

Water is always moving. It moves round and round, from the ground to the air, from the air to the ground. As it moves, it changes its form. You've learned the different forms water changes into.

The picture on this page shows how water is always moving. Finish the sentences on the picture. Use the words below. Starts with 1 at the bottom.

clouds
liquid water

condenses
precipitation

evaporates
water vapor

2

Water vapor goes into the air. As the air cools, the water vapor

c _____. It

changes into tiny drops of liquid water.

Those tiny drops make c _____.

3

Water and frozen water vapor fall from the clouds as p _____.

1

Liquid water on the ground

e _____. The water

changes into w _____.

4

Precipitation falls on the ground. It becomes l _____ that's on the ground.



Looking at the Sky

Sometimes you can guess what the weather will be like. How? By looking at the sky.

Suppose there are no clouds in the sky. What will the weather be like?

Yes! The weather will be fair. No precipitation will fall.

All precipitation comes from clouds. But

precipitation can fall only from certain kinds of clouds.

The pictures on this page show a few important clouds. Some of the clouds are signs that precipitation will fall. Some are signs of fair weather.

Look at the pictures. Then look at the sky. What do you think the weather will be like for the rest of the day?

Bad Weather Clouds



Precipitation is about to fall

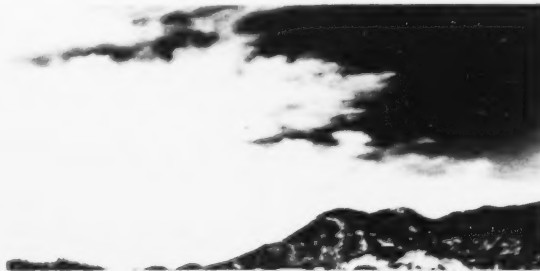


Precipitation may fall



Precipitation may fall

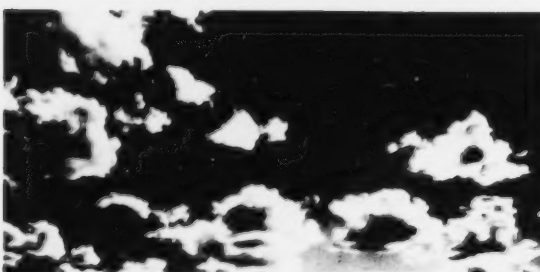
Fair Weather Clouds



Fair weather ahead



Fair weather ahead



Fair weather ahead

Weather Watch

What's the weather like today? Fill in the weather report.

Today's Weather Report

Date: _____

Time: _____

Temperature: _____

Wind speed: _____

Air pressure: _____

Humidity: _____

Are clouds in the sky?

☐ Yes ☐ No

If clouds are in the sky, describe what they look like.

Is fog in the air?

☐ Yes ☐ No

Is precipitation falling?

☐ Yes ☐ No

If your answer is yes, what kind of precipitation is falling?

- ☐ Light rain
- ☐ Heavy rain
- ☐ Sleet
- ☐ Hail
- ☐ Light snow
- ☐ Heavy snow

Check Yourself

Show what you learned in this unit. Use the words below to complete the crossword puzzle.

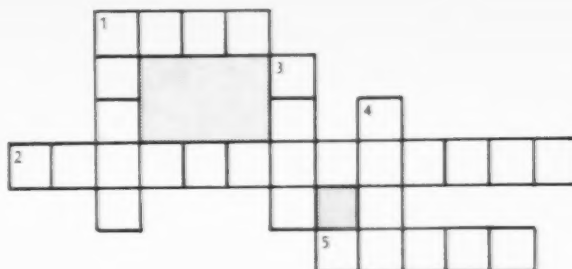
cloud	precipitation	sleet
hail	rain	snow

Across

- Precipitation that is frozen water vapor.
- Water that falls from clouds.
- What condensed water vapor makes in the sky.

Down

- Precipitation that is frozen ice drops.
- Precipitation that is liquid water.
- Precipitation that is balls of ice.



Check These Out

- Find out what other kinds of clouds there are. Find out what kind of weather each kind of cloud brings.
- What kind of clouds bring lightning? How dangerous is lightning? What are lightning storms? Find out what to do and not do during lightning storms.
- Find out all you can about hail. Why do water drops turn into big ice balls? What does the inside of a hailstone look like?
- Here are more things you may want to find out:
 - How big is a raindrop? How is a raindrop made?
 - What does a snowflake look like? Do all snowflakes look alike? Why does a snowflake change shape as it falls?
 - How can scientists make rain fall from clouds?
 - These words are used in weather reports. What do they mean? *Haze, mist, overcast, partly cloudy, patchy fog, variable clouds.*

Meteorologists work at weather stations.



NOAA photo

Unit 6

What Will the Weather Be Like?

It's early morning. You're listening to a weather report. The weather reporter says:

"Rain is likely today."

Sure enough, it rains during the day. How do weather reporters know what the weather will be like?

They find out what the weather will be like from **meteorologists**. Meteorologists are scientists who study weather.

Meteorologists work in weather stations. They use special instruments to measure the temperature, pressure, and humidity of the air. They study winds and clouds. They see where air masses are moving to. They find out what the weather is like in different places.

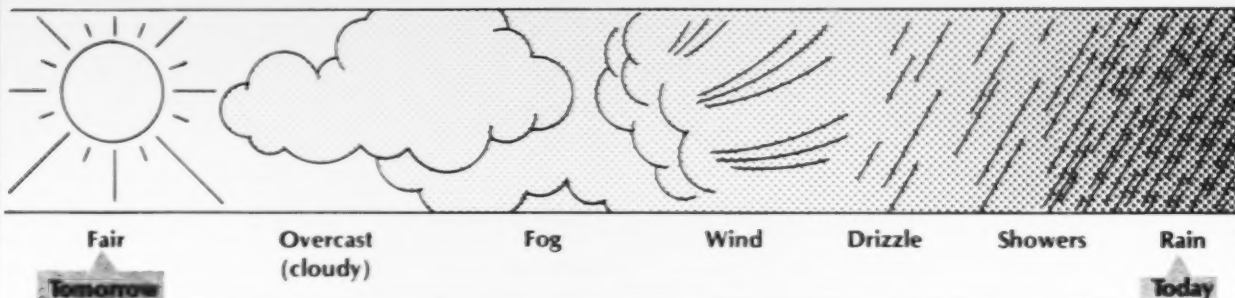
Weather moves when air masses move. For example, there may be storms right now in an air mass hundreds of miles away from you. But the weather in your area is fair. If the air mass moves to your area, you'll have storms too.

Meteorologists can tell if the air mass is moving your way. They can **predict** (guess) exactly when the storms will be in your area.

Some weather reports show what meteorologists predict. What do you think those reports are called?

Weather reports that predict weather are called **forecasts**.

Weather Forecast for Today and Tomorrow



Today and Tomorrow

Rain all day today. Rain ending late tonight. Mostly fair tomorrow. Lows mostly 40s tomorrow night. Highs 60s. Southeasterly winds 15 to 30 mph.

Tuesday through Thursday

Partly cloudy Tuesday. Fair Wednesday and Thursday. Fog at nights and in the mornings. Highs 50s to low 60s. Lows 30s.

A Weather Forecast

The weather report on this page shows what a forecast might be like in a newspaper. (The report is from a Sunday newspaper.)

Read the forecast. Then answer these questions.

1. Will it rain today?

2. Will it rain tomorrow?

3. When will the rain end?

4. What will the high temperature be tomorrow night?

5. How strong will the winds be tomorrow?

6. What will the weather be like on Wednesday and Thursday?

Weather Watch

Listen to a TV weather report. Or get a weather forecast from a newspaper and paste it below. Then answer the questions about tomorrow's forecast.

Tomorrow's Forecast

Tomorrow's Date: _____

1. What will the highest temperature be? _____

2. What will the lowest temperature be? _____

3. Will there be any wind?

☐

Yes

☐

No

4. Where will it come from?

5. How strong will it be?

6. What will the water in the air be like?

☐

Clear

☐

Partly cloudy

☐

Overcast (cloudy)

☐

Foggy

7. Will it rain or snow?

☐

Yes

☐

No

8. What else does the weather forecast predict?

Show What You Learned

What's the Answer?

Each sentence has three correct endings.
Put an X in front of each correct ending.

1. Weather changes when
 - _____ a. heat in the air changes.
 - _____ b. different kinds of air masses meet.
 - _____ c. the amount of water in the air changes.
 - _____ d. air pushes down on anything it touches.
2. Air pressure
 - _____ a. is always changing.
 - _____ b. is how fast air moves.
 - _____ c. rises when air gets heavier.
 - _____ d. is high when the weather is fair.
3. Water changes in these ways:
 - _____ a. water changes into ice when it melts.
 - _____ b. water changes into water vapor when it evaporates.
 - _____ c. water vapor condenses and forms clouds.
 - _____ d. water changes into ice when it passes through cold air.
4. Some kinds of precipitation are:
 - _____ a. snow.
 - _____ b. water vapor.
 - _____ c. rain.
 - _____ d. hail.
5. Weather reports can tell you
 - _____ a. how high and low the temperatures are.
 - _____ b. how strong the winds will be tomorrow.
 - _____ c. what time it is.
 - _____ d. if it will rain tomorrow.

What's the Word?

Write the correct words for the meanings.

1. Water that falls from the sky
P _____
2. Moving air that is hundreds of miles wide
A _____ M _____
3. How hard air pushes down on anything it touches
A _____ P _____
4. Liquid water that changes into a gas
W _____ V _____
5. The amount of water vapor in the air
H _____
6. Air that moves quickly
W _____

Glossary

air mass: moving air that is hundreds of miles wide

air pressure: how hard air pushes down on anything it touches

anemometer: something that measures the speed of winds

barometer: something that measures how heavy air is

block: a large amount

cloud: a large group of tiny water drops that float together in the sky

condense: change from a gas to a liquid

degrees: amounts of heat in the air

evaporation: change from a liquid to a gas

fog: a large group of tiny water drops that float together near the ground

forecast: a report of what the weather will be

frozen: turned into ice

hail: balls of ice that fall from the sky

humidity: having a lot of water vapor in the air

humidity: the amount of water vapor in the air

hygrometer: something that measures the amount of water vapor in the air

instrument: something that measures

measure: find out the amount of something

meteorologist: a scientist who studies the weather

miles per hour: the speed of wind

precipitation: water that falls from the sky

predict: guess what might happen

rain: drops of liquid water that fall from the sky

rotate: spin

sleet: ice drops that fall from the sky

snow: frozen water vapor that falls from the sky

temperature: how hot or cold something is

thermometer: something that shows how much heat is in the air

tornado: a very strong, spinning windstorm

water vapor: the gas form of water

wind: air that quickly moves

Congratulations!

**You've learned a lot about weather.
You've learned:**

- what happens when weather changes;
- some ways to predict weather;
- how to use weather reports; and
- many other important facts about weather.

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